DOCUMENT RESUME

ED 151 999 EC 103 917

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TITLE Vocational Training and Production Supervision: A Review of Habilitation Techniques for the Severely and Profoundly Retarded. Revised.
INSTITUTION Oregon Univ., Eugene. Rehabilitation Research and Training Center in Mental Retardation.
SPONS AGENCY Office of Human Development (DHEW), Washington, D.C. Office of Developmental Disabilities.
PUB DATE Jan 77
NOTE 47p.; Print of the original is marginal and may not reproduce well in hard copy; Chapter in Habilitation of Severely and Profoundly Retarded Adults: Reports from the Specialized Training Program
AVAILABLE FROM University of Oregon, Rehabilitation Research and Training Center in Mental Retardation, Clinical Services Building, University of Oregon, Eugene, Oregon 97403 ($2.00)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Adults; Behavior Change; Contingency Management; Custodial Mentally Handicapped; Employment Potential; Reinforcement; *Severely Handicapped; Teaching Techniques; Trainable Mentally Handicapped; *Vocational Rehabilitation

ABSTRACT

Reviewed is research concerned with the vocational habilitation of severely and profoundly retarded adults, particularly ways to train the requisite job skills and increase performance of existing skills to appropriate rates. Noted are reports of training programs in which severely retarded Ss were taught complex skills such as assembling a 25-piece bicycle brake. Practical teaching techniques (such as shaping, physical priming, and modeling) are explained. Techniques for supervising production levels using both token and social reinforcement are also described. It is stressed that if the vocational difficulties of severely handicapped adults are viewed as skill deficits rather than deficits in individual potential, then improved vocational training for the severely handicapped should ensue. (DB)

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EC103917

January 1977 Revision

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Vocational Training and Production Supervision: A Review of Habilitation Techniques for the Severely and Profoundly Retarded[1]

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Legal decisions and parental pressure have led to an emerging national commitment to appropriate education and training for all handicapped individuals. Carried to its logical conclusion this philosophy should result in a significant increase in the services available to severely handicapped adults. Decisions regarding the right to treatment within institutions (Wyatt vs. Aderholt, 1971) and the present emphasis on deinstitutionalization suggest that communities must be prepared to offer daily vocational, educational and recreational programs to adults in need of specialized services. A strong emphasis on vocational opportunities in these programs will reflect the significant role of work in our society and will be consistent with professional interest in both normalization and individual development.

Among those most immediately affected by the press toward deinstitutionalization are the severely retarded. For them, a changing array of potential community services offers some promise that the gap between research results and traditional expectations may be narrowed. This situation appears to have generated considerable

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[1] This is a draft of a chapter prepared for N. Haring & D. Bricker (Eds.), Teaching the Severely and Profoundly Handicapped, Vol. III. Preparation was supported in part by grants from the Developmental Disabilities Office, Region X, to the University of Oregon Center on Human Development.

interest in a more thorough examination of research and practice relating to the development of vocational opportuntities for severely and profoundly retarded adults. Thus, while the material reviewed in this chapter may be relevant to other groups labeled severely handicapped, it is unlikely that it will be as complete for them.

The assumptions and values with which a body of knowledge is approached often have much to do with both the questions which are posed and the conclusions which are drawn (Kuhn, 1962). In this discussion of the vocational habilitation of the severely and profoundly retarded, retardation will be viewed as a problem of behavioral deficits which can be remediated through adequate environmental programming, rather than as an irreversible condition arising from an impaired intellectual functioning (Bijou, 1963; Lindsley, 1964; Myerson, Michael, Mower, Osgood & Staats, 1960).

For some time prevalent views of severe and profound retardation have included a notion of limited potential, a belief that retardation causes or is necessarily associated with an inability to perform a variety of normal activities like communicating with others, taking care of personal needs, living in the community, and participating in vocational opportunities. Following the numerous demonstrations of the acquisition of skills, many of these assumed limitations are being discarded by both professional and public groups. Nevertheless, the belief in limited vocational potential has proven to be resilient. Adult programs continue to be established "for handicapped clients whose physical or mental impairment is so severe as to make their

productive capacity inconsequential" (Federal Register, 1974, p. 17509).

As has been the case with other skill areas, a growing research literature suggests that the concept of limited vocational potential so often assigned to retarded persons should be replaced with a recognition of the possibility of vocational competence after structured training. There are numerous reports that adults, who clearly fall within the AAMD definitions of severe and profound retardation (Grossman, 1973), are able to learn a variety of vocational skills. For example, Loos and Tizard (1955) were able to train six "imbeciles" to fold and glue together cardboard cake boxes. Then Clarke and Heremelin (1955) taught these same adults to cut insulated wires to exact length, to solder four colored wires to color coded terminals of an eight-pin television plug, and to complete a nine-component bicycle pump assembly. After a lapse of more than a decade and with roughly the same population of retarded adults, other studies have reported similar results in teaching such skills as stripping and sorting plastic components (Williams, 1967), manufacture of wooden pencil holders and flower baskets (Crosson, 1966. 1969). assembly of a 12-piece bicycle brake (Gold, 1974), assembly of 24- and 26-piece printheads and assembly of a 52-piece cam switch actuator (Bellamy, Peterson, & Close, 1975), bagging garlic bulbs and labeling them for commercial sale (Friedenberg & Martin, 1975). and construction of a difficult cable harness (Hunter & Bellamy, 1976). Thus, over a 20-year period the work potential of this population has been repeatedly demonstrated.

Taken together, these demonstrations provide a realistic basis for

questioning whether it is useful to associate various levels of retardation with assumed limitations of individual potential for vocational and/or other behavioral skills. In fact, the research does much to support the contrasting view of retardation which provides the framework for this review. Deficit vocational behaviors imply a need for improved environmental programming, not a limitation on a retarded person's work potential. The salient question now facing habilitation specialists is not whether severely and profoundly retarded adults can be taught the skills necessary to function independently in a vocational setting, but rather how best to teach these skills.

From this perspective, if a profoundly retarded adult is unable to function in a vocational setting, there are at least two possible explanations. First, the worker may not have the necessary skills to fulfill the job requirements. Such a deficit can result from a lack of necessary response topographies or a deficit in stimulus control that makes a worker unable to satisfy the contingencies in a particular work setting. For example, if a task requires a worker to use a screwdriver and the worker does not know how to hold and twist the tool, then s/he will be unable to complete the task satisfactorily. To overcome this type of problem, the worker must be taught the necessary response topographies. However, even if a worker has the topographies to use a screwdriver, if s/he fails to stop twisting the screwdriver when a screw becomes snug, the threads may become stripped or the head fouled. That is, the worker may not be sensitive to critical changes in the work environment. The solution is to provide training specifically

designed to establish stimulus control; i.e., to bring appropriate response topographies under control of task-related stimuli.

A second explanation for vocational incompetence may involve an inordinately low work rate. That is, a worker could have the necessary response topographies and be under sufficient stimulus control so as to complete the task without errors, but if the rate of production is grossly inadequate, it is unrealistic to place the individual in a normal work environment. To overcome this type of problem, environmental programs must be designed to increase work rate to an acceptable level.

The present review discusses the problems of skill acquisition and work rate which contribute to vocational incompetence in severely and profoundly retarded adults. Specifically, the following section examines training techniques to alleviate skill deficits. The subsequent section deals with production supervision techniques which increase work rates.

Techniques for Vocational Training

In view of the gap between popular expectations regarding what severely and profoundly retarded adults are capable of learning and what they actually can do when given proper instruction, it seems prudent to review the literature to determine how others have managed to overcome what must have been difficult teaching problems. Therefore, this review of training techniques describes how several vocational tasks were taught, although many aspects of the training procedures are not described in the published reports.

Loos and Tizard (1955) were faced with teaching six retarded males, whose IQ's ranged from 24 to 41, to fold cardboard cake boxes, a job requiring nine discrete movements to be made with "both hands, neatly and in a specific order" (p. 397). However, before formal training started, each subject was taught "to fold." (As will be discussed later, this constitutes what Becker (1971) refers to as teaching an operation.) According to Loos and Tizard, vocational training involved:

> No unusual techniques of training. . . . Rather the boys were first shown how to do the job and coached singly for about an hour. The group then worked under the supervision of the experimenter for a fortnight. When a patient failed to do the correct things in the correct order he was made to begin again and go through the whole sequence of movements correctly. (p. 397)

In a subsequent study Clarke and Heremelin (1955) were able to teach these same adults three industrial-like tasks: (a) a task requiring the use of a guillotine to cut an insulated wire to exact length (±¼"), (b) a soldering task in which four different colored wires were soldered to the correct terminal of an eight-pin television plug, and (c) a simple bicycle pump assembly task requiring nine different operations. Training on the first task involved explaining the task sequence, twice demonstrating (modeling) the proper sequence, then letting the worker cut five wires as practice, and finally "helping and correcting as necessary" (p.338). It is not entirely clear how the second task was taught but apparently the trainees were assisted (primed) through

the task until they could perform the soldering task unaided. In the third task workers were given "one demonstration of the assembly and then aid[ed] to follow the experimenter in each operation" (p.339).

In a much more recent report Williams (1967) was able to train a single male, labeled profoundly retarded, to strip plastic components by initially "holding [the worker's] hands and forcing the action of pulling apart until he began to dislike this physical coercion so much that he did it himself" (p. 17). Then, evidently, various other sorting tasks were taught in the same fashion though specific information is not given about how these simple operations were taught. Crosson (1966, 1969) successfully trained seven severely retarded adult males to complete one task requiring the use of a drill press to make wooden pencil holders and a second task involving the use of a hammer to build flower boxes. The first step in the training program was to specify the component parts of each task, i.e., the "functionally integrated units of behavior (operants) making up [the] response sequences" (1969, p. 814). Then, once the operants had been identified, the task was further analyzed to determine which stimulus cues were associated with each operant. Actual training was conducted by providing a demonstration "of the component behaviors in their proper sequence" (p. 815) and immediately prompting the trainee to imitate the modeled response. Immediate reinforcement, in the form of praise, candy and tokens, was delivered contingent upon the worker emitting the correct movement in the presence of the appropriate stimulus. In the final states of training extrinsic reinforcers were faded out as

were all other verbal cues or physical primes used in the early stages of training.

Bellamy, Peterson and Close (1975) trained two profoundly retarded adults to assemble a 19-piece cam switch actuator. The trainee was seated in front of a work tray, similar to that described by Gold (1972), where all the required parts were arranged in the order of use. The trainer then modeled each new step of the task after which the trainee was expected to perform that step without assistance. When correct responses were emitted, reinforcement (in the form of praise, edibles, or physical contact) was delivered immediately. Incorrect responses were followed by a correction procedure where "The trainer provided assistance with a verbal direction, model, or physical prime. . . . Then asked [the worker] to repeat the step" (p. 12).

Friedenberg and Martin (1975) trained two severely retarded men to place garlic bulbs into plastic bags and then staple on labels so the items could be sold in grocery stores. In the author's own words:

> The trainer began by physically modeling the steps necessary to obtain a completed product while stating verbally the operations he was performing according to the task analysis. He then told the student to try the task. An inability to complete a step correctly was dealt with first by a non-punitive indication of error ("Try it another way"). If this had no effect, a verbal direction was given such as "hold the bag tightly." If the verbal instruction did not result in the subject correcting his error, a physical cue

was given in the form of the step being modeled by the trainer with accompanying verbal instructions. The fourth level of correction (priming) consisted of manipulating the subject's hands to help him complete the step correctly. No tangible reinforcement was given.

Hunter and Bellamy (1976) trained three severely retarded adults to construct an eleven-wire cable harness laced with a continuous elastic cord so it would retain its original shape when installed in an oscilloscope. First, a detailed task analysis was performed. Training consisted of one-to-one instruction beginning with a single demonstration of each step in the task. After that, the trainee was given the opportunity to complete each step on his/her own. When close approximations were emitted a variety of reinforcers were given including edibles, compliments and money. Incorrect or unacceptable responses were consequated by a correction procedure in which the trainer either modeled the correct response and/or physically primed the worker through the correct response. The trainee was then given another opportunity to emit an acceptable approximation.

Another series of vocational training studies deserves particular attention, although most of the published reports focus on adults labeled moderately retarded. In a series of studies of assembly skill acquisition, Gold and his co-workers (Gold, 1972, 1974; Gold & Barclay, 1973a) have developed efficient training procedures for assembly of two bicycle brakes. In these studies, training began by seating a worker at a table upon which lay a compartmentalized tray with parts

enough to complete four entire brake assemblies. Then the trainer would give one demonstration showing correction and reinforcement procedures, i.e., the trainer brought forward each part, placed it within the appropriate compartment, and then assembled the entire unit. During the demonstration, "Errors were made, according to a standardized demonstration format, and verbal cues that would be given when the subject made an error were used. The most frequently used cue was, 'Try another way'" (1972, p. 7). Furthermore, "To correct manipulation problems it was sometimes necessary to give more verbal assistance" (p. 8). Ater a successful correction procedure the verbal response "Good" was given and the same cue was given at the end of each trial. More recent reports have noted the utility of these techniques with other tasks (Levy, 1975) and with more severely handicapped individuals (Gold, 1975).

Of particular importance in Gold's work is the systematic comparison of the relative effects of variations in training procedure on measures of training time, retention and transfer. Moderately retarded subjects learned to assemble a bicycle brake faster when permanent color cues highlighted discriminations in assembly (Gold, 1972). However, when these cues were used as a training device and removed, so that ultimate performance was on the unmarked brake, acquisition was no more efficient than with direct training (Gold, 1974). In another comparative study in which procedures involved altering features of the work task itself, Gold and Barclay (1973b) taught a bolt sorting task involving a difficult length discrimination (a difference of 1/8 inch between the

two bolts). Teaching involved one of two methods, simple differential reinforcement, and training on progressively more difficult discriminations, beginning with bolts which differed 3/4 inch in length, and continuing until the original task was learned. The latter procedure was more efficient.

Another comparative study further explored the issues raised in the Gold and Barclay (1973b) results. Irvin and Bellamy (1976) taught three groups of severely retarded adults a simple assembly task involving a difficult visual discrimination (distinguishing between 2 sides of a hex nut, one of which was raised .10 cm.). Each of three training conditions involved manipulation of stimulus features of the task, so that an easy discrimination could be taught first; then these stimulus changes were gradually removed until the criterion task was learned. Stimulus feature changes involved addition and reduction of large cue differences on the relevant dimension (The convex face of the nut was exaggerated.); adding and fading redundant color cues; and a combination of these. With this task, the combination resulted in the most efficient learning, with the color cues ranking second.

In its entirety, this collection of vocational training studies reflects considerable variation among professionals as to how vocational skills should be taught to severely and profoundly retarded adults, and some differences in how training procedures are conceptualized and described. In spite of these ambiguities, however, three things seem clear. First, there are various techniques or teaching methods that "work" in the sense that they serve to functionally

improve vocational skills in severely and profoundly retarded adults. Second, low IQ scores do not preclude acquisition of difficult vocational tasks. Third, it appears that successes enjoyed to date are highly correlated with the fact that planned training programs were used in which tasks were broken down into their component parts and then taught to the workers directly.

Some Practical Techniques

During the past 20 years various teaching techniques based on behavioral theory have evolved which, when systematically applied, make good use of whatever potential a learner brings to the learning situation. In this section, a few of the most frequently used techniques for direct vocational training are discussed.

Problems in response topography. There are at least four basic methods that can be used to teach new response topographies or to improve the quality of responses already in an individual's repertoire. Though each is listed below as a separate technique, actual training usually involves the use of two or more simultaneously.

1. Shaping. This basic procedure is used to improve the quality of an overt response by differentially reinforcing successive approximations until the individual reaches a criterion level of behavior. That is, reinforcement is delivered contingent upon responses that more and more closely approximate the desired behavior. As training proceeds, i.e., as the trainee learns the task, the criterion for reinforcement goes up accordingly. In addition, when shaping a new motor skill the trainer has the choice of a) waiting for the learner

to emit approximate responses on his/her own (which, strictly speaking, constitutes a "pure" shaping paradigm) or b) attempting to evoke superior approximations by assisting the learner in one way or another. In either case, it is understood that as the responses become more task specific they must be differentially reinforced to improve the topography (quality) over time.

The advantage of using a pure shaping paradigm is that, with the significant exception of the presence of a trainer, the learner is not exposed to superfluous discriminative stimuli (stimuli not normally present in the production setting) during training. This means there will be no subsequent need to transfer stimulus control, via fading procedures, before the worker can work independently in a production setting. But by the same token, a pure shaping paradigm may have a marked disadvantage in that it requires the trainee to emit reasonable approximations on his/her own, a process that may involve considerable waiting on the part of the trainer. In fact it is usually for the sake of saving time that most trainers argue for using "extra support" In the early stages of training. The contention is that by intervening they can get the trainee to emit fairly close approximations without delay. This not only speeds acquisition of new response topographies but it also avoids emotional reactions on the part of the trainee due to a history of "wrong" or unsatisfactory responding.

The remaining three techniques involve the provision of additional information prior to the trainee's response in order to maximize the probability that the desired response topography will be emitted. Each

of these techniques relies on the application of shaping principles as well. Specifically, they all begin with a low criterion for reinforcement, and as training proceeds the criterion level for reinforcement is gradually raised. Problems inherent in fading out trainer assistance are treated separately in the next section dealing with problems of stimulus control.

2. Physical priming. Whereas a pure shaping paradigm requires the trainer to wait for the learner to make increasingly better approximations on his/her own, physical priming involves physically holding and then moving the trainee through the desired motor response. This technique allows the trainee to experience very close approximations to the criterion response without having to suffer through what might be a lengthy period of incorrect responding after which there is no reinforcement. Further, it may avoid periods of long pausing that may well slow down training and subsequent production to the extent that "pausing" becomes a discriminative stimulus correlated with a superstitious chain consisting of a pause, a correct response, and then reinforcement. As mentioned above, the problem with this method of teaching new response topographies is that "correct responding" often comes under control of being held or touched by the trainer, since in the early stages of training this stimulus condition often sets the occasion for reinforcement. Transferring stimulus control to stimulus conditions associated only with the task can be a difficult problem. In general, as with any kind of trainer-assisted instruction, physical priming should be used with the idea of eliminating the

primes as quickly as possible. The longer they are used, the more difficult the withdrawal.

3. Modeling. On some occasions it may be possible to teach a skill by having the learner watch while the trainer demonstrates the correct motor response or a component of it. This procedure is usually adequate with individuals who can reliably imitate the trainer's demonstration. However, it is less likely that it will suffice, without prior imitation training, to teach vocational skills to many severely or profoundly retarded adults. One positive aspect of this technique is that a modeled response can lead to fairly good approximations after which it may be comparatively easy to further refine the response topography by shaping.

4. Verbal directions. As was the case with modeling, verbal instructions about the behaviors required by a task or the necessary discriminations may be sufficient to occasion correct responses from many individuals. This technique, however, is unlikely to be effective with the more severely retarded. Nevertheless, some data are available which suggest that the systematic use of verbal cues can facilitate acquisition by individuals whose language ability can be questioned (Gold & Barclay, 1973a).

A useful conceptual framework emerges when these last three techniques which involve trainer assistance are analyzed. Verbal directions, modeling and physical priming will be effective teaching techniques only to the extent that they provide useful information to the trainee, i.e., increase the probability of desired response topographies so that

successive approximations can be reinforced. If, in fact, these sets of stimuli (teaching techniques) function as effective discriminative stimuli for the desired responses, the trainee may be said to have an operation. According to Becker (1971), "Operations are the essential response characteristics shared by a set of responses in a given universe of operations. Instances are to a concept as individual responses are to an operation" (p.413). For example, a trainee would be expected to improve the topography of a desired response after the response was modeled only if some form of a generalized imitation skill was present. Similarly, verbal and physical cues will be effective only if the trainee has a generalized skill of following these cues with appropriate matching responses. A key issue in the efficacy of vocational training would thus appear to be the extent to which necessary operations are in a trainee's repertoire. Considerable attention has been paid to teaching generalized imitation skills to severely handicapped adults, but other operations have received less attention. An important exception is the work of DeBriere (1976) who taught severely handicapped adults a generalized skill of following picture cues in small parts assembly. Continued research is needed to evaluate the relative efficiency of direct training on individual tasks and prior training to establish some of these generalized skills, or operations, which could facilitate future learning.

Problems in stimulus control. Generally speaking, as a worker proceeds with a task, the stimulus characteristics associated with that task change accordingly, i.e., as something is put together it

looks and feels different at each step in the chain. Ideally, these distinctive stimulus characteristics should function to inform the worker what to do next. If a worker has not learned which stimuli set the occasion for a particular response then some way must be found to teach these critical discriminations. To achieve this goal there are several ways to arrive at what behavior analysts call stimulus control. But, varied as these are, they all aim at getting the worker to attend to, i.e., respond as a function of, critical changes in the stimulus aspects of the task at hand.

In general, there are three practical techniques that can be used to improve stimulus control.

1. Differential reinforcement. This method for establishing stimulus control involves reinforcing, immediately if possible, all members of a specified response class in the presence of a defined stimulus condition. Noninstances as well as instances emitted outside the appropriate stimulus condition are never reinforced, i.e., they are extinguished.[2] A program using differential reinforcement will teach a worker what must be done and when, providing the program is carried out in a systematic fashion and providing the worker is able to determine what are and are not relevant stimulus dimensions.

In many discrimination problems differential reinforcement is either an ineffective teaching method or is inefficient in terms of

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[2] Particularly good examples of this approach are described by Crosson (1966) and Screven, Straka and LaFond (1971).

both training time required and number of errors made (Gold & Barclay, 1973b; House & Zeaman, 1960; Sidman & Stoddard, 1967). For these problems two other general approaches are available, each of which relies on the use of differential reinforcement plus some additional changes in the antecedent stimulus conditions.

2. The first of these procedures involves manipulation of stimulus features of the task in order to accentuate the relevant dimension to which the trainee must attend and respond differentially. This may involve either adding and then gradually reducing large cue differences on the relevant dimension or adding and fading a redundant dimension which has a high degree of salience for the trainee. In either case the purpose of these stimulus feature manipulation approaches is to establish stimulus control over the trainee's behavior, then to gradually remove the added cue information until the original task occasions correct differential responding.

3. The other general antecedent-related method of establishing stimulus control involves gradually fading trainer assistance. As was noted above, the trainer can often increase the probability of correct responding by providing verbal instructions, models of the response, or physical primes. As this assistance is gradually faded, the trainee's behavior is usually expected to come under the stimulus control of the task. Fading may involve gradual reduction in the amount and specificity of information, as in replacing a direction like, "The raised side goes up," with a less informative direction such as, "Try again," or in replacing a complete model of the response with a simple demonstration

of the initial hand position. Another fading approach involves gradually increasing the latency between presentation of the necessary trainer cue and the appearance of the task-provided discriminative stimulus. That is, the instruction, "The raised side goes up," might at first be given as the trainee picks up the part in question. Then, in later training trials the time interval between the instruction and the opportunity to perform the step could be lengthened while the trainee continues to respond correctly to the characteristics of the part itself.

Whichever method of establishing stimulus control is used, a special circumstance is encountered in many repetitive work tasks. When work involves repeated progression through a set sequence of behaviors, conceptualization of a signle work cycle as an operant chain can be useful. Basically, a chain is a specified series of responses each of which is associated with a unique stimulus condition. In turn, each salient stimulus condition should function in two ways: First, each discriminative stimulus (except for the very last) should set the occasion for the subsequent response in the chain, and second, each should function as a conditioned (or secondary) reinforcer for the previous response(s). (For a detailed analysis the reader is referred to Kelleher, 1966.) Theoretically, this situation is what maintains a response chain until the very last response is emitted which, instead of leading to another discriminative stimulus, sets the occasion for reinforcement in the form of praise, tokens, money, etc.

The training issue is how to teach such a sequence of responses

most efficiently, so that the dual function of the associated stimuli is established and subsequent responding is free of pauses and errors. Both forward (e.g., Gold, 1972; Hunter & Bellamy, 1976) and reverse (e.g., Screven, Straka & LaFond, 1971) chaining techniques have been used with success. The relative merits of the two procedures and their possible interaction with various task characteristics needs more investigation.

The present review has shown the utility of viewing vocational skill deficits as a problem of training rather than as evidence of limited potential. From this, one thing now seems clear. Although questions still remain as to what are the most effective methods for teaching vocational skills, the questions now facing us are amenable to empirical investigation. Only more time and effort are needed to solve these seemingly complex issues.

Techniques for Supervising Production

The practical utility of work skills acquired by severely handicapped adults will depend to a great extent on the rate and manner in which these skills are performed on the job. The task of production supervision, therefore, is to change rates of work and work-related behaviors in the production setting, so that normal productivity and acceptable work behaviors result.

Individual work rates are of central importance in sheltered vocational programs. By law they provide the basis for all remuneration. They are used by the Department of Labor and several other service

agencies to classify both individuals and programs (Federal Register, 1974). Work rates also affect the overhead income of vocational programs and thus are an important aspect of the economic feasibility and subsidy needs of these programs. Further, some data are available indicating that work rates may affect supervisors' global performance ratings, on the basis of which employment decisions can be presumed to be made (Chaffin, 1969).

Work-related behaviors in production settings have occasioned considerable comment and study. Such behaviors as attending to tasks, disruption of co-workers, self initiation, social interactions with co-workers, persistence and quality of work are clearly important in successful long-term employment.

That rates of work and work-related behaviors vary widely in sheltered vocational programs is evidenced by the voluminous attempts to account for this variability, as noted by Cobb (1969), Gold (1973), and Wolfensberger (1967). As indicated by Bellamy (1976) much of the literature attempts to relate productivity to three sets of variables and their interactions: characteristics of individual workers; characteristics of the work tasks performed; and characteristics of the physical and social setting. In keeping with the practical focus of the present chapter, research will be reviewed which describes the behavior of severely and profoundly retarded adults and presents specific supervision techniques which may be useful in changing production rates.

With few exceptions research on productivity has been limited to studies of workshop clients, who are primarily mildly or moderately

handicapped. Thus, the lack of studies which focus specifically on the severely handicapped simply reflects their relative absence in workshop programs. The research which is available has dealt primarily with the effects of contingent consequences on rates of work or task attending behaviors. Three of the six adults participating in the Loos and Tizard (1955) boxfolding task would now be labeled severely retarded. In that study, performance during six and one-half hour work days was observed under various supervisory conditions. During the first five weeks of observation production rate was considerably higher in each of two weekly 50 minute "supervised" periods than at other times. During these periods workers were encouraged to work as fast as possible and discouraged from engaging in non-work behaviors. Loos and Tizard (1955) then provided graphical representation of productivity by filling in squares on a histogram as soon as a worker completed 150 boxes, thereby allowing comparison of performance with previous days. Introduction of the graphs was followed by an immediate increase in production of over 200%, but this gradually declined to baseline levels during the five weeks in which the contingency was in effect. Loos and Tizard (1955) and Clarke and Heremelin (1955) note that this group subsequently was able to perform work reliably and consistently and that individual work rates could be significantly changed by altering the method of supervision. Although some aspects of the total supervision system employed by Loos and Tizard (1955) are unclear, their work provided a convincing demonstration that sustained work performance was within the capabilities of the severely retarded adults in their sample. Further, they

demonstrated that production rate can be expected to vary considerably within work days and over more extended periods. Some rate variation can be reasonably attributed to the supervision procedures used, although much remains unexplained.

Crosson (1966) compared the work rates of 22 institutionalized severely and profoundly retarded adults under two different reinforcement conditions. Subjects worked under both an unspecified social reinforcement contingency intended to simulate a normal workshop setting and a specifically programmed fixed ratio contingency with token reinforcement. Work was performed during ten 24 minute periods under each contingency. Results indicated (a) statistically reliable differences between the token and social reinforcement conditions for each task and (b) an accelerating response rate across all tasks and both contingencies, which was interpreted by the author as a practice effect. It is unclear from the report whether performance differences should be attributed to type of reinforcement (social vs. tokens) or type of contingency (planned fixed ratio vs. unsystematic) and whether these differences can be expected to maintain over extended work periods. Nevertheless, Crosson's (1966) work demonstrated the effects of supervision procedures on initial work rates, and anticipated many of the issues still of concern a decade later.

Teasdale and Joynt (1967) reported the use of a token reinforcement procedure for supervising production efforts of five Down's Syndrome adolescents, some of whom were apparently severely retarded. Each performed a simple task, involving threading string through a packaging label, on which they had had considerable previous experience. Work was performed under two

token reinforcement conditions. The first was a "cooperation" condition, or group contingency, in which the total performance of the group determined the reinforcement. The second was a "competition" condition. Both resulted in performance levels above undefined "normal" working conditions, although the design allows for several possible interpretations of this rate change.

Two studies by Zimmerman and his co-workers (Zimmerman, Stuckey, Garlick, & Miller, 1969; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969) further evaluated the use of specifically planned contingencies of reinforcement in supervising production. Multihandicapped workshop clients performed either a terminal board assembly task or folded Goodwill bags. Contingencies which resulted in replicable improvements in work rates included (a) giving points, which could be exchanged for privileges at the end of each day when production met defined goals, (b) assignment to an isolated work area when daily work rates fell below defined goals, and (c) choice of work assignment contingent on reaching defined daily production goals.

Screven, Straka and LaFond (1971) reported the use of an automated device to change work behaviors of severely retarded adults. The work task involved assembling a two-piece coin tube. The device provided a stimulus cue (light) when assembly behaviors were appropriate and dispensed token reinforcers on predetermined schedules for task completion. Intervention strategies included changes in schedule of reinforcement for task completion behaviors and use of the light as a time out device which followed inappropriate behaviors. The authors do not present

specific results, but report that, with this automatic supervision system, severely retarded adults were able to work at rates comparable to that of less handicapped clients with considerable stability of performance.

Two of the workers included in the Trybus and Lacks (1972) investigation apparently were functioning within the range of severe retardation. Work involved simple packaging and assembly tasks. For one worker an undefined contingency of token reinforcement for increases in production rates resulted in higher production rates than did either a baseline or a differential reinforcement of other behavior (DRO) condition. The worker reached a maximum of about 50 percent normal productivity during the token condition. The other worker exhibited several behaviors in the work setting which were construed as work-interfering behaviors (out of chair, turning around in chair, extended talk, refusing to use some parts). Each of these behaviors was reduced to near-zero frequency when supervisor attention was withheld following their emission.

Karen, Eisner and Endres (1974) used a token reinforcement system with adults labeled severely retarded. Each worker was involved in some aspect of preparing tin cans as nursery specimen cans. Work was performed during three hour and fifteen minute work days, but data were obtained during only 12 minutes of observation each day. Tokens were given on what was described as a variable interval schedule for appropriate work behaviors. Observation data indicated an increase in attending to task with the token reinforcement as

compared to baseline conditions in a reversal design, and some decrease in errors during treatment. Overall productivity appeared little affected, however, and a two- or three-fold increase in production during followup suggests that all subjects may have been working somewhat inefficiently throughout the study. Nevertheless, the results do support the utility of supervisor controlled contingencies in changing rates of the work related behaviors of task attending and performance accuracy.

The use of social contingencies to increase work rates was the focus of a study reported by Bellamy, Peterson and Close (1975). A severely retarded man assembled a 52-piece cam-switch actuator under baseline conditions which were not defined and under treatment conditions in which supervisors were instructed to provide either social priase or prompts to return to work every two minutes. The effectiveness of the increased supervisor contact was demonstrated in a reversal design, with production rates during treatment frequently above the normal time standard for the product.

In two additional case studies with adults labeled severely retarded, Bateman (1975) successfully increased the amount of time spent on specific work activities. In each case, when the opportunity to work on a more preferred task was made contingent on prior performance of a less preferred task, time spent on the less preferred task increased. In spite of the extremely short time frame of the study (two days in each experiemental condition), the results demonstrated the possible use of the Premack principle in vocational supervision.

Two studies reported by Martin and Flexer (1975) provide further evidence that on-task behaviors of workers can be increased by varying supervision procedures. In both studies, workers were asked to work for gradually increasing periods of time, with reinforcement contingent on maintaining work behaviors throughout the period. On-task behaviors, productivity, and independence from supervisor prompts were increased.

The production studies discussed above strongly suggest that productivity levels of severely and profoundly retarded adults must be attributed at least in part to the type of supervision they receive. Unfortunately, many variables in the supervision process simply have not been explored with this population. Therefore, the information needed to define effective comprehensive supervision procedures is not available. However, research with less severely handicapped workers does offer some additional suggestions. For example, as Bellamy (1976) noted, the work rates of retarded individuals have been related to a variety of procedures including: (a) providing definitive instructions which encourage competition (Gordon, O'Connor and Tizard, 1955; Huddle, 1967) or set performance goals (Gordon, O'Connor and Tizard, 1954; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969; Kliebhahn, 1967); (b) providing contingent positive reinforcement for work behaviors, using such consequences as money (Schroeder, 1972; Huddle, 1967; Brown, Van Deventer, Perlmutter, Jones & Sontag, 1972), music (Bellamy & Sontag, 1973; Cotter, 1971; Podvin, 1967), edibles (Brown, Johnson, Gadberry & Fenrick, 1971) and knowledge of results (Levy, 1974; Jens & Shores, 1969); (c) changing the contingency relationship between the

work performance and reinforcing event (Schroeder, 1972; Trybus & Lacks, 1972); (d) providing contingent punishing consequences for low work rates (Zimmerman, Overpeck, Eisenberg & Garlick, 1969; Greene & Hoats, 1969; Screven & LaFond, 1973); (e) arranging for work with a more compentent co-worker (Abel, 1938; Brown & Pearce, 1970; Kliebhahn, 1967). Thus there are a variety of potential changes in the work environment which may improve production rates. Until more applied research is completed with severely and profoundly retarded workers, these studies with the more mildly handicapped may provide some assistance in the design of useful supervision techniques.

Some Practical Implications

In evaluating the applicability of production research with both mildly and severely retarded populations, the practitioner must ask whether there are systematic differences between the reported experimental situations and the applied vocational settings in which the results may be utilized. Three questions seem particularly relevant: (a) Are the results generalizable to the larger population of severely and profoundly retarded adults who may be included in vocational programs? (b) Can the relationships between various supervision procedures and productivity be expected to maintain over the extended time periods which are inherent in practical vocational programs? and (c) Are the experiemental treatments feasible in practical vocational programs?

Applicability to the severely and profoundly retarded population. With the exception of Crosson's (1966) work, most production

studies involved subjects who were either enrolled in vocational programs or specifically selected for those programs. It is difficult to evaluate whether this selectivity has systematically eliminated some severely handicapped individuals whom future vocational programs will be expected to serve. The applicability of findings across individuals will thus be clearer if future production research efforts systematically include groups who may have been denied entrance to vocational programs.

A specific issue in applicability across individuals is the possibility that many stimulus events which the production supervisor can control might have less influence on the behavior of more severely handicapped workers. It is quite possible that the range of effective reinforcing events is reduced for some severely and profoundly retarded individuals. See, for example, the many efforts to identify effective reinforcing events for this group (Hollis, 1964; Tramontana, 1972; Watson, Orser & Sanders, 1967). It also seems likely that many discriminative stimuli, especially verbal communications, may be less useful with many severely handicapped individuals. Similarly, the utility of many contingency arrangements may be reduced by the initial inability of a worker to count, tell time, or otherwise monitor progress in relation to contingency requirements. These possibilities underscore the need to monitor individual performance under any supervision procedure, regardless of its previous effectiveness with other workers.

Applicability to long term vocational involvement. Most of the available research has evaluated the relationship between supervision

procedures and work performance during relatively brief time periods. Whether performance during the first few weeks after a procedure is implemented is representative of performance during several months or years in a vocational program is a valid question. Changes in work rates over time were found in several studies. In many of these, gradual improvement over time appears to reflect the effects of practice or exposure (Claridge & O'Connor, 1957; Crosson, 1966; Gold, 1973b; Gordon, 1962; Kahn & Burdett, 1967). In other studies, evidence is available that the effectiveness of contingency arrangements may decrease considerably over time (Loos & Tizard, 1955).

Applicability to actual workshop settings. The third possible impediment to research utilization reflects the practical realities of staff ratios, staff expertise, and equipment budgets in existing community programs. Research is needed to develop measurement systems and supervision procedures which can be implemented in typical workshop settings, and to develop and evaluate methods of staff training which will assist this implementation. The task of the practitioner charged with production supervision is to maximize the productivity and accuracy of each worker. Typically, this must be done in situations which are not maximally favorable research settings. For example, staff-worker ratios may be poor; supervision staff may not have access to necessary consultants; data processing and data display services may be totally absent; and type of work may vary considerably over time and across workers.

Some Specific Techniques

While the research on changing work rates clearly demonstrates the potential importance of supervision techniques, it does not

provide a practical guide for combining these techniques into a useful overall supervision system. However, a few practical suggestions can be made which do appear consistent with the available research. Each will require some additional expenditure of staff time, but to the extent that they result in higher production levels for individual workers, they should result in more efficient operation of a total vocational program.

(1) Distinguish between vocational training and production supervision functions and include a worker in the production supervision setting only after the topography of the work behavior has been established and brought under stimulus control of task cues. The individual attention which is necessary to correct problems in topography or stimulus control during training can often function as a powerful social reinforcer for error responses in a production setting where one-to-one attention is not usually available.

(2) Implement daily measurement systems for worker productivity, based on number of work units completed, on-task behavior, or both. Work units completed during given time intervals are frequently recorded for payroll information, and daily totals or averages could be made available to production supervision staff with little extra effort. On-task behavior may be monitored on jobs not easily divided into equivalent units by time sampling procedures. For example, whether each of a group of workers is on or off-task at the end of 5-minute intervals can be recorded in a few seconds by a supervisor with a simple timing device which signals when to observe and record.

(3) Identify events in the work environment which may function as reinforcing events for various workers, e.g., staff attention and assistance, access to various staff members for professional contact, assignment to preferred jobs, pay check advances, and so on.

(4) Plan systematic contingencies of reinforcement, using the events identified as consequences for task completion or task attending behaviors. Implementing these contingencies would be the primary role of the immediate floor supervisor.

(5) Evaluate the effectiveness of each contingency arrangement by noting its long term effects on the daily measures of productivity or attending behaviors of workers.

Summary and Recommendations

Research on habilitation of the severely and profoundly retarded provides an ample basis for viewing these individuals as potentially vocationally competent persons. Techniques are being developed which effectively remediate at least two kinds of problems which produce vocational incompetence: lack of the requisite skills, and performance of existing skills at inappropriate rates. For skill deficiencies, the literature suggests several approaches for both shaping desired response topographies and establishing necessary stimulus control. For problems of inappropriate rates, production supervision research with both severely and moderately handicapped individuals has illustrated several techniques which might be combined effectively by the practitioner who pragmatically evaluates their effect on individual productivity. In light of these results, policies and programs which presume that limited

vocational potential necessarily accompanies severe handicaps should be critically reviewed. Nonetheless, many questions remain about specific procedural issues in both training and supervision. Procedures should be refined for teaching generalized skills or "operations" which are functional in a variety of vocational situations. More efficient procedures are needed for teaching the complex operant chains which available work often requires. Applied research on supervision procedures is needed to identify combinations of procedures which are feasible in normal work settings, which allow for differences among individuals in specific procedures used, and which effectively maintain high work rates over long periods of time.

To view the vocational difficulties of severely handicapped adults as skill deficits rather than deficits in individual potential has several implications. For the community programs which may now begin to serve these adults, this view should affect both the objectives of the programs and the persons who are selected for participation. Vocational participation and remuneration is an objective which is both feasible in community programs and consistent with professional values of normalization and individual development (Roos, 1975). It should thus be one of the criteria on which quality of these programs is evaluated. Further, severely handicapped adults should be selected for inclusion in more vocational programs. In the past, the feasibility criterion imposed by vocational rehabilitation agencies has prevented the severely handicapped from taking advantage of many vocational services. Functionally, this feasibility criterion has been the adult

counterpart of the exclusion clause which kept many severely handicapped children out of public schools before court intervention. However, the vocational training and supervision research reviewed here suggest that lack of feasibility must be attributed more to availability and quality of vocational programs than to an inherent limit on individual potential. Gold's (1973) concern with the misuse of assessment procedures is still timely. Scores obtained from standardized tests and certain work sample procedures appear to bear little practical relationship to actual performance following training. Yet, there are considerable individual differences in response to vocational training and supervision procedures. It is clear from the research that training will be much more difficult, expensive and time consuming for some severely handicapped individuals than for others. If assessment instruments could be devised which reliably predicted the time or cost of the needed training and supervision, selection and placement decisions might be made on a more empirical basis without presupposing limits on individual productivity. A preliminary description of such an assessment effort is reported by Bellamy and Snyder (1976).

To view severely and profoundly retarded adults as potentially vocationally competent individuals has many implications for the roles of education, industry, and government. The feasibility of long term vocational goals places considerable responsibility on special education programs. Along with economic involvement, severely handicapped individuals may be able to participate competently in many aspects of community life, if they have the necessary skills. Therefore,

educational programs for the severely handicapped must focus on longitudinal objectives, develop sequenced instructional goals which lead toward those objectives, and insure that the skills taught are, in fact, utilized in students' natural environments. (Brown, Nietupski, & Hamre-Nietupski, 1976; Williams, Brown & Certo, 1975.)

A response from government and industry to the vocational competence of the severely and profoundly retarded is also needed. As vocational opportunities become available to this group, they should be included in national manpower planning and considered for a variety of work possibilities that are now subcontracted outside this country. Despite tacit acceptance of the phrase "Hire the handicapped," those who are severely involved are rarely even considered as potential employees. The research and program results reviewed here suggests that this is an unnecessary exclusion.

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